CLAIMS

1. Solid oxide fuel cell including a cathode, an anode and at least one electrolyte membrane disposed between said anode and said cathode, wherein said anode comprises

- a cermet including a metallic portion and an electrolyte ceramic material portion, said portions being substantially uniformly interdispersed, said metallic portion having a melting point equal to or lower than 1200°C and being substantially inert as catalyst for hydrocarbon oxidation; said cermet having a porosity equal to or higher than 40%, and being activated by a catalyst for hydrocarbon oxidation in an amount equal to or lower than 20 wt%.

2. Solid oxide fuel cell according to claim 1, wherein the metallic portion is selected from a metal such as copper, aluminum, gold, praseodymium, ytterbium, cerium, and alloys thereof.

3. Solid oxide fuel cell according to claim 2, wherein the metallic portion is copper.

4. Solid oxide fuel cell according to claim 1, wherein the metallic portion has a melting point higher than 500°C.

5. Solid oxide fuel cell according to claim 1, wherein the weight ratio metallic portion/ceramic portion in the cermet ranges between 9:1 and 3:7.

6. Solid oxide fuel cell according to claim 1, wherein the weight ratio metallic portion/ceramic portion in the cermet ranges between 8:2 and 5:5.

7. Solid oxide fuel cell according to claim 1, wherein the ceramic material has a specific conductivity equal to or higher than 0.01 S/cm at 650°C.

8. Solid oxide fuel cell according to claim 8, wherein the ceramic material is selected from, doped ceria and $La_{1-x}Sr_xGa_{1-y}Mg_yO_{3-\delta}$ wherein x and y are comprised between 0 and 0.7 and δ is from stoichiometry.

9. Solid oxide fuel cell according to claim 7, wherein ceria is doped with gadolinia or samaria.

10. Solid oxide fuel cell according to claim 1, wherein the ceramic material is yttria-stabilized zirconia.

11. Solid oxide fuel cell according to claim 1, wherein the cermet has a specific surface area equal to or lower than 5 m^2/g.

12. Solid oxide fuel cell according to claim 11, wherein the cermet has a specific surface area equal to or lower than 2 m^2/g.

13. Solid oxide fuel cell according to claim 1, wherein said catalyst is selected from nickel, iron, cobalt, molybdenum, platinum, iridium, rhutenium, rhodium, silver, palladium, cerium oxide, manganese oxide, molybdenum oxide, titania, samaria-doped ceria, gadolinia-doped ceria, niobia-doped ceria and mixtures comprising them.

14. Solid oxide fuel cell according to claim 13, wherein said catalyst is selected from nickel, cerium oxide and mixtures comprising them.

15. Solid oxide fuel cell according to claim 1, wherein said catalyst is present in an amount ranging between 0.5 wt% and 15 wt%.

16. Solid oxide fuel cell according to claim 1, wherein said catalyst has a specific surface area higher than 20 m^2/g.

17. Solid oxide fuel cell according to claim 16, wherein said catalyst has a specific surface area higher than 30 m^2/g.

18. Solid oxide fuel cell according to claim 1, wherein the cathode comprises a metal selected from platinum, silver, gold and mixtures thereof, and an oxide of a rare earth element.

19. Solid oxide fuel cell according to claim 1, wherein the cathode comprises a ceramic selected from

- $La_{1-x}Sr_xMnO_{3-\delta}$, wherein x and y are independently equal to a value comprised between 0 and 1, extremes included and δ is from stoichiometry; and

- $La_{1-x}Sr_xCo_{1-y}FeyO_{3-\delta}$, wherein x and y are independently equal to a value comprised between 0 and 1, extremes included and δ is from stoichiometry.

20. Solid oxide fuel cell according to claim 18, wherein the cathode comprises doped ceria.

21. Solid oxide fuel cell according to claim 1, wherein the cathode comprises a

combination of materials as from claims 18 and 19.

22. Solid oxide fuel cell according to claim 1, wherein the electrolyte membrane is selected from yttria-stabilized zirconia, $La_{1-x}Sr_xGa_{1-y}MgyO_{3-\delta}$ wherein x and y are comprised between 0 and 0.7 and δ is from stoichiometry, and doped ceria.

23. Solid oxide fuel cell according to claim 1, wherein the electrolyte membrane comprises the same material of the electrolyte ceramic portion of the cermet.

24. Method for producing energy comprising the steps of:

a) feeding at least one hydrocarbon fuel into an anode side of a solid oxide fuel cell including

- an anode comprising a cermet including a metallic portion and an electrolyte ceramic material portion, said portions being substantially uniformly interdispersed, said metallic portion having a melting point equal to or lower than 1200°C and being substantially inert as catalyst for hydrocarbon oxidation; said cermet having a porosity equal to or higher than 40%, and being activated by a catalyst for hydrocarbon oxidation in an amount equal to or lower than 20 wt%;

- a cathode, and

- at least one electrolyte membrane disposed between said anode and said cathode;

b) feeding an oxidant into a cathode side of said solid oxide fuel cell; and

c) oxidizing said at least one fuel in said solid oxide fuel cell, resulting in production of energy.

25. Method according to claim 24, wherein the hydrocarbon fuel is substantially dry.

26. Method according to claim 24, wherein the hydrocarbon fuel is methane.

27. Method according to claim 24, wherein the hydrocarbon fuel is directly oxidized at the anode side.

28. Method according to claim 24, wherein the hydrocarbon fuel is internally reformed

at the anode side.

29. Method according to claim 24, wherein the solid oxide fuel cell operates at a temperature ranging between 400°C and 800°C.

30. Method according to claim 29, wherein the solid oxide fuel cell operates at a temperature ranging between 500°C and 700°C.

31. Process for preparing a solid oxide fuel cell including a cathode, an anode and at least one electrolyte membrane disposed between said anode and said cathode wherein said anode comprises a cermet including a metallic portion and an electrolyte ceramic material portion; said process comprising the steps of:

- providing a cathode;

- providing at least one electrolyte membrane; and

- providing an anode

wherein the step of providing the anode includes the steps of:

a) providing a precursor of the metallic portion, said precursor having a particle size ranging between 0.2 μm and 5 μm;

b) providing the electrolyte ceramic material having a particle size ranging between 1 μm and 10 μm;

c) mixing said precursor and said ceramic material to provide a starting mixture;

d) heating and grinding said starting mixture in the presence of at least one first dispersant;

e) adding at least one binder and at least one second dispersant to the starting mixture from step d) to give a slurry;

f) thermally treating the slurry to provide a pre-cermet;

g) reducing the pre-cermet to provide a cermet

h) distributing at least one catalyst for hydrocarbon oxidation into the cermet.

32. Process according to claim 31, wherein the slurry resulting from step e) is applied on the electrolyte membrane.

33. Process according to claim 31, wherein step h) comprises impregnating the pre-cermet with a precursor of the catalyst which is subsequently reduced during the reducing step g).

34. Process according to claim 31, wherein step h) comprises impregnating the cermet with a precursor of the catalyst which is subsequently reduced during an additional reducing step i).

35. Process according to claim 31, wherein the precursor of the metallic portion is an oxide.

36. Process according to claim 35, wherein the oxide is a copper oxide.

37. Process according to claim 35, wherein the oxide is CuO.

38. Process according to claim 31, wherein the precursor has a particle size ranging between 1 and 3 μm.

39. Process according to claim 31, wherein the ceramic material has a particle size ranging between 2 and 5 μm.

40. Process according to claim 31, wherein step d) is carried out more than one time.

41. Process according to claim 31, wherein the at least one first and second dispersants are selected from ethanol and isopropanol.

42. Process according to claim 31, wherein the at least one first dispersant is the same of the at least a second dispersant.

43. Process according to claim 31, wherein the binder is soluble in the at least one second dispersant.

44. Process according to claim 31, wherein the binder is polyvinylbutyral.

45. Process according to claim 31, wherein step f) is carried out at a temperature ranging between 700°C and 1100°C.

46. Process according to claim 45, wherein step f) is carried out at a temperature ranging

between 900°C and 1000°C.

47. Process according to claim 31, wherein step g) is carried out at a temperature ranging between 300°C and 800°C.

48. Process according to claim 47, wherein step g) is carried out at a temperature ranging between 400°C and 600°C.

49. Process according to claim 31, wherein step g) is performed with hydrogen containing from 1 vol.% to 10 vol.% of water.

50. Process according to claim 49, wherein hydrogen contains from 2 vol.% to 5 vol.% of water.

51. Cermet including a metallic portion and an electrolyte ceramic material portion, said portions being substantially uniformly interdispersed, said metallic portion having a melting point equal to or lower than 1200°C and being substantially inert as catalyst for hydrocarbon oxidation; said cermet having a porosity equal to or higher than 40%, and being activated by a catalyst for hydrocarbon oxidation in an amount equal to or lower than 20 wt%